Fatigue among South African adolescents living with HIV: Is the Chalder Fatigue Questionnaire a suitable measure and how common is fatigue?

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Conflicts of Interest

None.

Abstract

Evidence suggests that HIV-infected adolescents experience elevated levels of fatigue that impacts their functioning at school and other important aspects of their lives. Yet, fatigue has not been measured amongst this population group. In this cross-sectional, mixed-methods study we explored the psychometric properties of the 11-item Chalder Fatigue Questionnaire (CFQ) amongst 134 South African adolescents (11-18 years old) receiving antiretroviral therapy (ART) in the Western Cape. Using the Likert scoring method for the CFQ, the mean total score was 14.89 (SD=3.83) and about a quarter (n=33, 24.63%) of adolescents scored ≥ 18, indicating problematic levels of fatigue. The CFQ demonstrated good internal consistency with a Cronbach's alpha of 0.83 (0.84, with item 11 deleted), which is comparable to other validation studies. On the first iteration of the principal component analysis (PCA) with a Varimax rotation, three factors accounted for 59.15% of the variance. However, the third factor consisted of one item only which we chose to remove from the analysis. On the second iteration of the PCA, a two factor solution was retained that accounted for 54.24% of the variance. The first factor, 'Physical fatigue', represented the first eight items on the scale. The second factor 'Mental fatigue' represented items nine and ten. The CFQ also demonstrated modest content and construct validity. The CFQ is a short, easy-to-use and cost-effective measure of fatigue, and demonstrates reliability and validity amongst a South African sample of adolescents. Given the high rate of fatigue amongst our participants, we recommend that future interventions be developed to reduce fatigue among HIV-infected adolescents, which may ultimately lead to improvements in school performance and social functioning. Future research may include test-retest reliability of the CFQ in order to show stability over time.

Keywords

Fatigue; adolescents; HIV; South Africa; Chalder Fatigue Questionnaire

Introduction

Fatigue is a common and disabling symptom among persons living with HIV (Barroso & Voss, 2013), but little is known about how to assess it among adolescents, particularly in low and middle income countries where rates of HIV in this age group are highest (Joint United Nations Programme on HIV/AIDS [UNAIDS], 2014). Chronic fatigue is a prolonged state of tiredness, exhaustion and lack in energy (Schuft, Duval, Thomas, & Ferez, 2017). It is inherently subjective and as such, is most frequently assessed by self-report e.g. questionnaires. As fatigue itself is often fluctuating by nature, its measurement can be particularly challenging (Hewlett, Dures, & Almeida, 2011). To further understand fatigue in this population, a reliable and valid measure of fatigue, which is brief, easy to administer and cost-effective is required.

Fatigue is relatively common and disabling in adolescence, with at least 1% - 3% of children and adolescents in the United States experiencing chronic, disabling fatigue lasting for at least 3 months (Crawley et al., 2012; Lamers, Hickie, & Merikangas, 2013; Norris et al., 2017) . Similarly, in a large scale epidemiological study, just under one third (30.3%) of British adolescents between the ages of 11-15 were found to develop fatigue over a 4 to 6 month follow-up period, and 1.1% reported symptoms in keeping with the more tightly defined criteria for chronic fatigue (i.e. severe fatigue lasting at least 6 months that is not improved by rest and interferes with family, social, academic or recreational functioning) (Rimes et al., 2007). Fatigue has a detrimental effect on functioning and has been linked to school absence and poorer academic achievement (Fowler, Duthie, Thapar, & Farmer, 2005; Loades, Coetzee, Du Toit, & Kagee, 2018; Sankey, Hill, Brown, Quinn, & Fletcher, 2006; ter Wolbeek, 2006).

The Chalder Fatigue Questionnaire (CFQ) (Chalder et al., 1993), is a brief measure of the severity of fatigue, both physical (e.g. weakness, lack of energy, reduced muscle strength) and mental (e.g. concentration, memory). The CFQ has been used in various physical illness

populations in adolescents, including meningococcal disease (Borg, Christie, Coen, Booy, & Viner, 2009), cancer (Aksnes, Hall, Jebsen, Fosså, & Dahl, 2007), and chronic fatigue syndrome (Chalder, Deary, Husain, & Walwyn, 2010; Missen, Hollingworth, Eaton, & Crawley, 2012). It has also been used among adults living with HIV (e.g. (Henderson, Safa, Easterbrook, & Hotopf, 2005; Rabkin, Wagner, McElhiney, Rabkin, & Lin, 2004)). There is evidence of the CFQ having good validity and reliability across a number of studies of its psychometric properties (Cella & Chalder, 2010; Cho et al., 2007; Tanaka et al., 2008), with evidence of sensitivity to change (Hewlett et al., 2011).

A number of previous studies have examined the psychometric properties of the CFQ in non-Western populations. However, we have found no studies in South Africa on the psychometric properties of the CFQ. In a cross-cultural validation of the CFQ in a Brazilian primary care population (N = 204), internal consistency as measured by Cronbach's alpha was 0.88 (Cho et al., 2007) and a 2 factor solution was replicated, consistent with studies in Western populations (Cella & Chalder, 2010). In a construct validity study of the CFQ among Japanese early teens (N=60), the scale had a 4 factor structure which explained 63.2% of the variance in the data (Tanaka et al., 2008). In this study, Cronbach's alpha was 0.73 indicating good internal consistency, and the 30 to 60 day test-retest reliability was 0.55 as measured by Spearman's rank correlation (Tanaka et al., 2008). Among a sample of 201 Chinese adults, the original 2 factor solution (mental and physical fatigue) was replicated. Further, internal consistency as measured by Cronbach's alpha was 0.86 and the CFS had high convergent and divergent validity with the Hospital Anxiety and Depression Scale (HADS) and Short Form Health Survey (SF12) (Wong & Fielding, 2010).

The CFQ is a brief measure of fatigue severity which has been used across a number of non-Western populations, among adolescents with chronic illnesses, and among adults with HIV. It has not, to our knowledge, previously been used among adolescents living with

HIV. The primary aim of the current study was to examine the psychometric properties of the CFQ among a population of adolescents with HIV in South Africa. A secondary aim was to establish the levels of self-reported fatigue on the CFQ in this population.

Methods

Design

We recruited a cohort of HIV-infected adolescents receiving antiretroviral therapy (ART) from public clinics in the Western Cape, South Africa. The study used a mixed-methods design (Creswell, 2013). The qualitative findings are described in detail elsewhere (Loades, Coetzee, Du Toit, & Kagee, 2017). We assessed fatigue amongst the participants using the CFQ, which is the focus of this paper.

Participants

Participants were adolescents, aged 11 to 18 years, who were living with HIV and attending an ART programme at community clinics or an infectious diseases clinic at a district hospital in the Western Cape, South Africa. To be eligible to participate, adolescents needed to be sufficiently competent in either English or Afrikaans (local language) to complete the measures. Exclusion criteria included significant developmental delay, requiring emergency medical attention, or experiencing florid psychotic symptoms or obviously acutely distressed.

Procedure

We invited consecutive clinic attenders who met the eligibility criteria to participate in the study. Clinic staff acted as referral agents, providing eligible adolescents with a participant information sheet. Interested participants met with the research assistant at the clinic or hospital site, who followed procedures for gaining informed consent. All participants provided written informed consent.

Measures

Fatigue: The CFQ (Chalder et al., 1993) is an 11 item scale assessing the severity of fatigue, both physical and mental. Respondents are asked to consider the past month in their recall, and to respond to each item on a 4 point scale, ranging from 0 to 3.

There are two ways to score this scale. The first is the Likert method in which scores are summed to calculate a total score out of a possible 33. A cut-off score of ≥ 18 has previously been used to determine those who have chronic fatigue in an adolescent population (Lloyd, Chalder, & Rimes, 2012). The second method is the bimodal method where endorsing either of the first two response options (less than usual, no more than usual) are scored 0, and either of the second two response options (more than usual, much more than usual) are scored 1. This gives a range from 0 to 11 with a total of 4 or more qualifying for problematic levels of chronic fatigue (Hewlett et al., 2011).

Mood: We used the 10 item depression subscale of the Revised Children's Anxiety and Depression Scale (RCADS) to measure depressed mood. The RCADS is designed to assess mood in children ages 7-18 (Chorpita, Moffitt, & Gray, 2005). In this study, one item from this scale (item 6 - which specifically pertains to tiredness) was used in our analysis to test construct validity of the CFQ.

Quality of Life: We used the Pediatric Quality of Life Inventory (PedsQL short form) (Varni, Seid, & Rode, 1999) to assess QOL. The PedsQL has previously been used in research among HIV-infected adolescents (Gazini et al., 2012). The PedsQL assesses quality of life in children and adolescents aged from 2 to 18 years. Quality of life is assessed by rating physical, mental, social, educational, and psychosocial performance, as well as overall quality of life. The overall score on the PedsQL ranges from 0 to 100 points. This score is directly proportional to quality of life. The child report version (11 to 12 year olds) or the adolescent version (13 to 18 year olds) was used. In this study, one item (item 8 – which

pertains to low energy levels) from this inventory was used in our analysis to test construct validity of the CFQ.

Qualitative Interviews: As mentioned previously, qualitative interviews were conducted with a subset (n=14) of our sample and these findings are reported elsewhere (Loades et al., 2017). This subset of participants were invited to take part in the interviews following completion of the measures above, including the CFQ. The participants were recruited from consecutive clinic attenders. Sampling of participants for the qualitative study progressed until no more new information was obtained from the interviews. These interviews followed a topic guide designed to explore the experience of fatigue, including the impact of fatigue on participants' daily lives and activities, what contributed most to their fatigue/tiredness including sleep, whether fatigue was related to mood, sources of support, and coping strategies (Loades et al., 2017). Interviews were audio recorded, transcribed verbatim and anonymised. In this paper, the anonymised qualitative transcripts were reviewed in detail by a researcher (RR) who had not been involved in the data collection and who was blinded to the respondents' CFQ scores, but who was familiar with fatigue and the CFQ. To assess the content validity of the CFQ (i.e. the extent to which the responses on the CFQ matched the narrative report of fatigue elicited in the qualitative interviews), RR scored the 14 qualitative transcripts against each of the items on the CFQ as absent or present within the narrative interviews. To do this, RR read through each transcript and marked each item on the CFQ as absent or present in the narrative, which was in keeping with the bimodal scoring procedure of the CFQ. The observer-rated scores (a score out of 11) were then correlated with participant's self-report scores (score out of 11).

Ethical considerations

This study was performed in accordance with the ethical standards of Stellenbosch University Health Research Ethics Committee (HREC N16/03/032), and the Western Cape Department of Health (WC2016RP142) and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Data analysis

Statistical analyses were conducted using SPSS v24, and p values <.05 (two-tailed) were considered statistically significant. Descriptive statistics including age, gender, ethnicity, social class, employment status, marital status, and religion were computed to describe the sample. We also calculated the mean (M) and standard deviation (SD) for the CFQ total scores (Likert scoring), as well as the M and SD for the subscales, physical fatigue (items 1-7) and mental fatigue (items 8-11).

For the psychometric properties of the scale the following analyses were conducted: (a) item-by-item descriptive analyses of the CFQ (b) internal reliability of the scale using Cronbach's alpha and exploratory factor analysis (EFA) using principal components analysis with an orthogonal (Varimax) rotation. An item was assigned to a factor if its factor loading was ≥ 0.40 (Floyd & Widaman, 1995). Sample size was adequate given the common rule of thumb of a 10:1 subject to variable ratio for principal components analysis (Tanaka et al., 2008).

To explore construct validity, Pearson's correlations were used to establish whether an individual's score on the CFQ was related to the tiredness item (item 6 – I am tired a lot) on the RCADS and the "I have low energy levels" item (item 8) on the PedsQL.

To explore content validity (i.e. whether the questionnaire looks valid), quantitative content analysis was used (Krippendorff, 2013). Pearson's correlation coefficients (r) were

used to determine the magnitude of the correlations between an individual's self-rated total scores on the CFQ (bimodal scoring) and observer rated total scores on the CFQ undertaken by an objective research assistant (xx).

Results

Sample Characteristics

As can be seen in Table I, our sample consisted of 134 (n= 78 female; n = 56 male) adolescents, with a mean age of 14.33 years. Twenty-four (17.9%) of the adolescents identified themselves as Coloured (mixed-race), while 82.1% identified as Black. In terms of social class, 70.1% of participants identified themselves as lower social class, while 28.4% identified as working class and 1.5% identified as middle class. Except for one, all adolescents were in high school, and one adolescent was employed part-time. All participants resided in the Western Cape, with 30.6% resident in Stellenbosch. Fifty-six percent of the adolescents stated they were religious Christians.

Rates of fatigue

Using the Likert method, about a quarter (n=33, 24.63%) of adolescents scored ≥ 18 on the CFQ, which is indicative of problematic levels of fatigue. Seventy-one (52.99%) adolescents demonstrated problematic levels of fatigue (scores ≥ 4) using the bimodal method of scoring.

The mean (M) score across all participants on the CFQ was M=14.89 (SD=3.83). The mean score on the physical and mental fatigue subscales was M=9.58 (SD=302) and M= 5.22 (SD=1.45), respectively. No significant difference was found between males and females (t (132) = -1.93, p>.05) on the CFQ.

Table I about here.

Reliability Analyses

Internal consistency of the CFQ

The CFQ showed high reliability (a = 0.83). Table II below shows the item-by-item descriptive analyses for the scale.

Table II about here.

Principal components analysis (PCA)

On the first iteration of the PCA, three factors were extracted (based on eigen values >1) that accounted for 59.18% of the variance. The first factor explained 38.63% of the variance, the second and third explained 11.25% and 9.31% of the variance respectively. However, only a single item (item 11) loaded onto the so-called third factor. Subsequently, item 11 was removed the analysis. As can be seen in Table III, on the second iteration of the PCA, two factors were retained (based on eigen values >1) that accounted for 54.24% of the variance.

Table III about here.

Table IV demonstrates the factor structure of the CFQ after rotation. Factor loadings >0.4 are bolded. Eight items loaded onto factor 1 (Physical fatigue), and two items onto factor 2 (Mental fatigue).

Table IV about here.

Validity Analyses

Independent-rater versus participant scores were modestly positively correlated (r = .62), demonstrating content validity. Table V provides the correlations between the CFQ total score and items related to tiredness and low energy on the RCADS and PedsQL. The CFQ is strongly positively correlated (r= .58) with item 6 on the RCADS, and strongly negatively correlated (r= -.65) with the PedsQL item.

Table V about here.

Discussion

Despite evidence to suggest that fatigue may be a considerable and troublesome symptom for adolescents living with HIV, there has been a lack of attention to it in previous research. In this study, and in our previous qualitative work (Loades et al., 2017) we have demonstrated that fatigue is salient amongst HIV-infected adolescents and that it is worth exploring further. To establish whether a brief and commonly used measure of fatigue may be useful in furthering the evidence, we examined the psychometric properties of the CFQ amongst clinic-attending HIV-infected adolescents in the Western Cape region of South Africa. We found that the CFQ demonstrated high internal consistency, and also found evidence of construct and content validity. Furthermore, we found that around a quarter (24.63%) to a half (52.99%) of our sample reported substantial symptoms of fatigue on the CFQ, depending on the scoring approach used.

Our findings showed that the CFQ is an appropriate measure of fatigue as it demonstrated high internal consistency. Typically, and largely amongst first language English speaking populations, the CFQ maintains a two-factor solution, namely physical fatigue and

mental fatigue. In our study, a three factor solution best represented the items on the scale. However, only one item loaded onto this 'third' factor and for this reason we deleted the item and retained a two-factor solution. According to Raubenheimer (2004), at least three items need to load onto a particular factor, while the loading of two items is still somewhat acceptable if it is deemed theoretically appropriate by the researcher (Raubenheimer, 2004). For this reason, we deemed it acceptable that factor two contained only two items, both of which had high factor loadings. Further, as can be seen in Table II, the reliability of the scale improves (from 0.83 to 0.84) when item 11 is deleted. As such, 10 as opposed to 11 items appear to be sufficient to measure fatigue amongst adolescents.

The occurrence of more than two factors using the CFQ is not unusual, as Tanaka et al. (2008) found a four-factor solution amongst their sample of Japanese teens. However, it should be noted that the original 14-item version of the CFQ was used in their study. Our findings suggest that adolescents in our study do not associate memory problems (item 11) with making slips of the tongue (item 9) or finding the right words (item 10). Ideally, these three items would cohere to form the second factor related to mental fatigue. A number of reasons could account for this distinction in items related to mental fatigue amongst our sample, 1) poor comprehension of the memory item by the adolescent, and 2) language difficulties. Tanaka et al. (2008) also suggest age and ethnicity as possible explanations.

We also found the CFQ to demonstrate validity. In terms of construct validity the CFQ total was positively correlated (r= .58) with item 6 (I am tired a lot) on the RCADS, and strongly negatively correlated (r= -.65) with the item 8 (I have low energy levels) on the PedsQL. These findings demonstrate that low energy levels and feeling tired are considered different constructs by adolescents in our sample. Further, in terms of content validity, independent-rater and participants' self-reported answers were modestly correlated (r= .62). However, this finding should be interpreted with some caution as we acknowledge that our

approach to establishing content validity using the data from qualitative interviews is novel, and the CFQ has not previously been used as an observer-rated measure.

Around one quarter to one half of our participants reported experiencing problematic levels of fatigue, depending on the scoring method used. Among adults with HIV, fatigue is the most commonly reported symptom (Barroso, 1999; Barroso & Voss, 2013) and in a large scale study of 13,768 adults with HIV in the USA, 37% reported fatigue (Sullivan, Dworkin, the Adult, & of HIV Disease Investigators, 2003). Among adults receiving ART, fatigue was reported in 71% of a sample of 953 adults (DiBonaventura, Gupta, Cho, & Mrus, 2012). A review of 42 studies found the prevalence of HIV-related fatigue to range from 33% to 88%, which included HIV-infected individuals who were undergoing treatment, as well as untreated individuals. Thus, the rate of fatigue in our cohort is consistent with these findings among adults. The findings are also consistent with findings in other paediatric samples with chronic illnesses where rates of fatigue have been found to be up to 75% in multiple sclerosis (Carroll, Chalder, Hemingway, Heyman, & Moss-Morris, 2016), and raised in children and young people with rheumatoid arthritis (Varni, Burwinkle, & Szer, 2004), neurological conditions (Nutini, Karczewski, & Capoor, 2009), and terminal cancer (Wolfe et al., 2000).

Our study has several limitations. First, the CFQ is a self-report measure, and therefore the severity of fatigue may have been over or underestimated amongst this sample. Second, we were unable to test the stability of the measure over time through test-retest reliability. Third, the approach to content validity using the data from qualitative interviews is novel and the CFQ has not previously been used as an observer-rated measure. Fourth, we noted a large discrepancy in the rates of fatigue when the two different scoring methods (likert and bimodal) were used. As such, it may have been useful to include an additional measure of fatigue to establish concurrent validity. Finally, our sample size was modest and our findings may not be representative of other clinical or community samples.

Conclusion

Many HIV-infected adolescents report elevated levels of fatigue which interferes most notably with concentration and productivity during school. We found evidence that the CFQ, which is a brief and easy to administer measure of the severity of fatigue, is a valid and reliable measure amongst this sample. We also found that a sizeable proportion of adolescents with HIV who were attending ART clinics in South Africa reported problematic levels of fatigue. We recommend that future research is aimed at designing appropriate interventions to assist adolescents to manage this fatigue in addition to the many demands associated with being on life-long chronic medication.

Table I. *Sample characteristics*

		Frequency	(%)	M	SD
Age (in years)				14.33	1.99
Gender	Female	78	58.2		
	Male	56	41.8		
Ethnicity	Mixed race (coloured)	24	17.9		
	Black	110	82.1		
Social Class	Lower	94	70.1		
	Working	38	28.4		
	Middle	2	1.5		
Employment status	High school student only	133	99.3		
	Part-time Employment	1	0.7		
Marital status	Single	134	100		
Residence in Western Cape	Stellenbosch	41	30.6		
	Mvuleni	1	0.7		
	Somerset West	7	5.2		
	Strand	32	23.9		
	Kayalitsha	3	2.2		
	Gordans Bay	14	10.4		
	Macassar	7	5.2		
	Nomsame	20	14.9		
	Asanda Village	2	1.5		
	Lwandle	3	2.2		
	Sir Lowry's pass	4	3		
Religion	None	54	40.3		
	Christian	75	56		
	Protestant	1	0.7		
	Catholic	1	0.7		
	Pinkster	1	0.7		
	Methodist	2	1.5		

Table II. *Item by item descriptive analysis of CFQ*

Item	Description	Corrected Item-Total Correlation	Scale Mean if Item Deleted	Scale Variance if Item Deleted	Cronbach's Alpha if Item Deleted
1	Do you have problems with tiredness?	0.59	13.43	13.89	0.81
2	Do you need to rest more?	0.65	13.33	13.50	0.80
3	Do you feel sleepy or drowsy?	0.54	13.29	13.97	0.81
4	Do you have problems starting things?	0.47	13.55	14.58	0.82
5	Do you lack energy?	0.64	13.32	13.71	0.80
6	Do you have less strength in your muscles?	0.57	13.54	14.20	0.81
7	Do you feel weak?	0.65	13.50	14.00	0.80
8	Do you have difficulties concentrating?	0.46	13.31	14.77	0.82
9	Do you make slips of the tongue when speaking?	0.39	13.60	15.26	0.82
10	Do you find it more difficult to find the right word?	0.38	13.46	15.17	0.83
11	How is your memory?	0.17	13.57	15.89	0.84

Table III. *Principal components analysis of fatigue scale*

Factor	Initial Eigenvalues		
	Total	% of Variance	Cumulative %
1	4.21	42.08	42.08
2	1.22	12.16	54.24
3	0.90	8.99	
4	0.86	8.61	
5	0.78	7.83	
6	0.57	5.73	
7	0.52	5.21	
8	0.40	4.03	
9	0.29	2.92	
10	0.24	2.44	

Table IV. *Factor structure of the CFQ following rotation*

		Factor	
	Description	1	2
1	Do you have problems with tiredness?	**0.77**	0.04
2	Do you need to rest more?	**0.79**	0.10
3	Do you feel sleepy or drowsy?	**0.56**	0.33
4	Do you have problems starting things?	**0.50**	0.32
5	Do you lack energy?	**0.77**	0.15
6	Do you have less strength in your muscles?	**0.73**	0.07
7	Do you feel weak?	**0.70**	0.26
8	Do you have difficulties concentrating?	**0.48**	0.29
9	Do you make slips of the tongue when speaking?	0.17	**0.80**
10	Do you find it more difficult to find the right word?	0.10	**0.85**

Table V. *Correlations between CFQ total score, RCADS item 6, PedsQL item 8*

		CFQ total score	RCADS-item 6	PedsQL-item 8
CFQ total score	Pearson Correlation	1	.55**	-.66**
	Sig. (2-tailed)		0.00	0.00
	N	134	134	134
RCADS_item 6	Pearson Correlation	.55**	1	-.56**
	Sig. (2-tailed)	0.00		0.00
	N	134	134	134
PedsQL_item 8	Pearson Correlation	-.66**	-.56**	1
	Sig. (2-tailed)	0.00	0.00	
	N	134	134	134

**. Correlation is significant at the 0.01 level (2-tailed).

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